MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

TIC2151 THEORY OF COMPUTATION/ TCS3511 THEORY OF COMPUTING

(All sections / Groups)

27th OCTOBER 2018
9.00 am – 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages only excluding the cover page.
2. Attempt all questions. The distribution of the marks for each question is given.
3. Please write your answers in the answer booklet provided. Please write the question number of each answer clearly.

QUESTION (1)

NOTE: Attempt any THREE out of FOUR Parts (A), (B), (C) and (D).

(A)

1. What is *Theory of computation*? [2 marks]
2. There are three common proof techniques that often occur in proving theorems in theory of computation. Name these proof techniques. [3 marks]

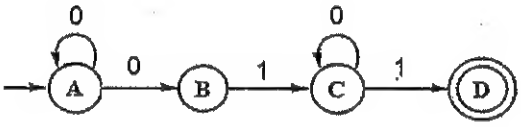
(B) Draw the state diagrams for DFAs accepting the following languages:

L_1= {w ∈ {a, b}* | w is the set of strings that start and end with the same letter} [2.5 marks]

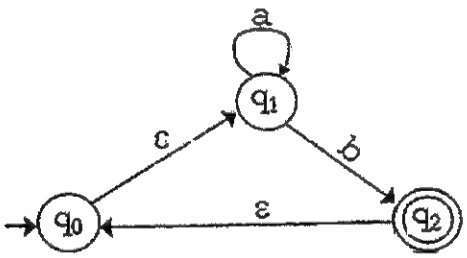
L_2= {w ∈ {a, b}*| w = a^2b^m, m≥0} [2.5 marks]

(C) Draw the state diagrams for DFAs accepting the same languages as the following NFAs. [5 marks]

M1

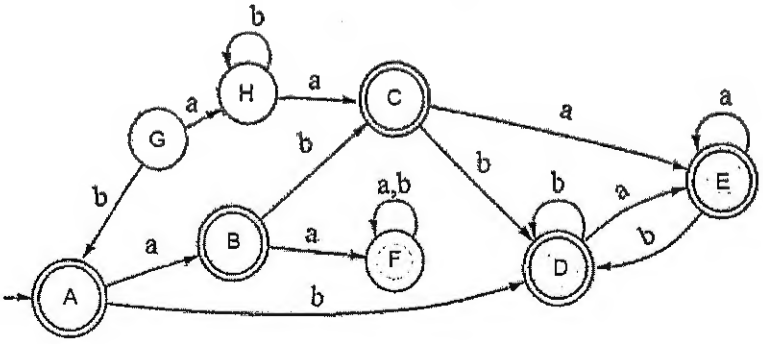


M 2



(D)

Minimize the following DFA. Show your steps. [5 marks]



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QUESTION (2)

(A)

1. Determine the language corresponding to each of the following regular expressions:

   i. $a(a+b)^{+}c^{+}$ [1.5 marks]

   ii. $a(a+b)^{*}b + b(a+b)^{*}a$ [1.5 marks]

2. Find regular expression corresponding to each of the following languages. [2 marks]

   i. $L = \{ w \in \{a, b\}^{*} |$ w contains exactly two a's.$\}$

   ii. $L = \{ w \in \{a, b, c\}^{*} |$ w contains *bcc* as a substring.$\}$

(B) Convert the following regular expression into an NFA. Follow the construction rules closely and do not just give a simpler NFA even though it is possible. [5 marks]

$$(0 + 1)^{*}(01 + 10)$$

(C)

1. Convert the following regular grammar into an NFA. [3 marks]

$S \rightarrow a \mid T$
$T \rightarrow bT \mid cQ \mid bbM$
$Q \rightarrow aaQ \mid ccN \mid aT$
$N \rightarrow cN \mid \varepsilon$
$M \rightarrow \varepsilon$

2. Give the regular grammars corresponding to each of the following languages over the alphabet {0, 1}.

$L_1 = 01^{*}\,01^{+}$ [1 mark]
$L_2 = 0\,(10)^{*}\,1$ [1 mark]

Continue...

QUESTION (3)

(A) Construct a PDA over the alphabet {a, b, c} for each of the following languages:

$L_1 = \{a^n c\, b^{2n+1} c \mid n > 0\}$ [3 marks]

$L_2 = \{a^m b^n c^{n+m+1} \mid n,m \geq 1\}$ [3 marks]

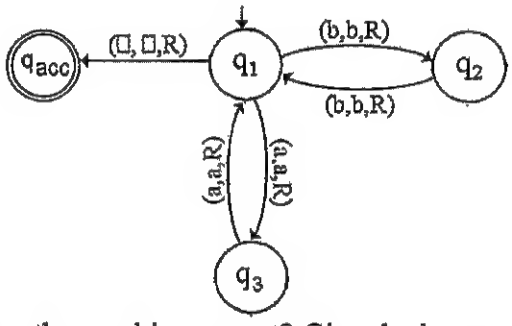
(B) Convert the following context-free grammar into Chomsky Normal Form (CNF). Show your main steps. [4 marks]

$S \rightarrow AbA$
$A \rightarrow Aa \mid \varepsilon$

QUESTION (4)

NOTE: Attempt any TWO out of THREE Parts (A), (B) and (C).

(A) Given the following Turing Machine:



1. What language does the machine accept? Give the language in regular expression form. [1.5 marks]
2. Give the formal definition of the machine including the transition table. [3.5 marks]

(B) Construct a Turing Machine for the language $L = \{a^n b^n c^m \mid m,n \geq 1\}$. [5 marks]

(C)

1. Briefly define *Turing-recognizable* languages. [2 marks]
2. For any two Turing-recognizable languages L_1 and L_2, let M_1 and M_2 be the TMs that recognize them. Prove by construction that the union of L_1 and L_2 is a Turing-recognizable language as well. [3 marks]

End of page.